REMARKS/ARGUMENTS

STATUS OF THE CLAIMS

By this amendment, Applicants have amended Claim 1 to correct a typographical error and added new Claims 15-19. Claims 2-14 remain unchanged. Accordingly, Claims 1-19 are pending in this application. In view of the following, Applicants respectfully request reconsideration and allowance of pending Claims 1-19.

INTERVIEW

Applicants' attorney appreciates the Examiner's time and consideration during the telephone interview on June 25, 2008. During the interview, Applicants' attorney Stephen A. Gigot (Registration No. 51,232), Hugo Jimenez and Examiners Cheryl Tyler and Azim Rahim discussed the rejections in the present Office action. In summary, the Examiners indicated that the type of fluid(s) mentioned in the claims was not examined as a limitation in the apparatus claims and that such language may be considered in the method claims. No agreement was reached.

CLAIM REJECTIONS 35 U.S.C. § 103

Claims 1-14 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 7,069,981 (from hereon the "'981 patent") and U.S. Patent Application Publication No. 2003/0129108 (from hereon "Burch").

Independent Claim 1 and dependent Claims 2-5

Claim 1 recites

A reformate cooling system for reducing the temperature of a reformate to within a desired temperature range for use in a fuel processing subsystem, the fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem; the reformate cooling system comprising:

at least one heat exchanger unit to transfer heat from the reformate flow to a portion of the process water flow, the at least one heat exchanger including a coolant inlet, a coolant outlet, a coolant flow path to direct the portion of the process water flow from the coolant inlet to the coolant outlet, a reformate inlet, a reformate outlet, and a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path, the heat exchanger having a sufficient effectiveness to fully vaporize the portion of the process water flow and bring the reformate flow and the portion of

the process water flow toward a common exit temperature under normal operating conditions for the fuel processing subsystem;

a valve connected to the coolant inlet to control the flow rate of said portion of the process water flow to the coolant inlet;

a temperature sensor positioned to measure an outlet temperature of the reformate; and

a controller connected to the temperature sensor and responsive thereto to selectively control the portion of the process water flow via the valve to regulate the common exit temperature to a desired temperature range.

As an initial matter, the Examiner incorrectly asserts on page 3 of the Office action that "Valensa et al. (i.e., the '981 patent) disclose a reformate cooling system (figs. 1-3)...". Applicants note that the '981 patent discloses a prior art heat exchanger 30 (shown in Fig. 1 of the '981 patent) and a second heat exchanger 50 shown in Figs. 2-11 of the '981 patent and that, in making the present rejection, the Examiner is combining elements from the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent with elements from the heat exchanger 50 illustrated in Figs. 2-11. Applicants respectfully submit that it is improper to arbitrarily select features from each of the two distinct heat exchangers 30, 50 and to recombine those features to create a hypothetical prior art heat exchanger because such a combination fails to recognize the significant differences between the two different heat exchangers 30, 50 and ignores the fact that the heat exchanger 50 illustrated in Figs. 2-11 was designed to overcome problems with the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent. Moreover, in creating such a hypothetical heat exchanger from the combination of the two heat exchangers 30, 50, the Examiner proposes to ignore the problems with the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent and to incorporate those problems into the hypothetical combined heat exchanger, despite the teachings of the '981 patent that such a construction is *not* desirable. Such a random combination can only be made by improperly failing to consider the '981 patent reference in its entirety. Moreover, as explained in greater detail below, the '981 patent teaches away from the Examiner's proposed combination.

In determining the differences between the prior art and the claims, the question under 35 U.S.C. 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983); *Schenck v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698 (Fed. Cir. 1983); MPEP §2141.02(I). A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention.

W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984); MPEP § 2141.02(VI). It is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983); MPEP § 2145(X)(D)(2).

The prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent includes "a recuperative heat exchanger 30 that transfers heat from the reformate produced by the ATR 26 to the humidified air/methane mixture from the humidifier." Column 1, lines 41-44. As clearly shown in Fig. 1, the two flow paths through the recuperative heat exchanger 30 of the prior art system referenced in the '981 patent are arranged for *counter flow*, not *concurrent flow* as required by Claim 1 of the present invention. Moreover, because the flow paths are arranged for counter flow, "the gas temperatures exiting the heat exchangers will therefore not be held within the desired temperature range at all flow rates, unless some sort of control system is incorporated with the heat exchanger 30." Column 2, lines 11-14. The heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent attempts to overcome these deficiencies by providing an entirely different system which, as explained below, cannot be reasonably combined with the heat exchanger 30 illustrated in Fig. 1 of the '981 patent. More specifically, "[t]he heat exchanger 50 shown in Fig. 2 (of the '981 patent) is a desirable replacement for the heat exchanger 30 and it's associated active control 38 because the heat exchanger 50 is able to maintain an essentially consistent output temperature to the ATR 26 and the LST 32." Column 5, lines 59-63.

Further, the '981 patent describes the heat exchanger 50 illustrated in Figs. 2-11 as being a significant improvement over the prior art heat exchanger 30 of Fig. 1 because the heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent "passively provid[es] what are essentially constant outlet temperatures over the operating spectrum of the fuel cell system 51 for both the humidified air/methane mixture and reformate, [and] the heat exchanger 50 is able to *eliminate the need for an active control scheme*, such as the control system 38[, which is shown in Fig. 1 of the '981 patent]." Column 6, lines 25-30 (emphasis added).

Accordingly, the '981 patent teaches away from the combination proposed by the Examiner. Moreover, as explained in more detail below, such a hypothetical combination still fails to include each and every element of Claims 1-19.

In addition, the Examiner incorrectly references the "humidified air/methane mixture" of the heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent and apparently considers the

humidified air/methane mixture to be the same as the *water flow* of Claim 1. The '981 patent discloses a flow of water supplied to a heat exchanger 22 and alternatively to another heat exchanger 36 (Fig. 1) to generate steam that is subsequently provided to an air/methane mixture, thereby forming the "humidified air/methane mixture." Although it is understood that the content of the humidified air/methane mixture includes a portion of water in gaseous form, the Applicants respectfully submit that it is improper to classify such mixture as a "water flow". Moreover, Applicants respectfully submit that the heat transfer and other properties of the humidified air/methane mixture of the system of Figs. 2-11 of the '981 patent differentiate the humidified air/methane mixture from a flow of water.

In addition, the '981 patent does not teach or suggest a reformate cooling system including, among other things, at least one heat exchanger unit to transfer heat from the reformate flow to a portion of the process water flow. The Examiner incorrectly asserts on page 3 of the Office action that the '981 patent discloses "at least one heat exchanger unit (30 or 50) to transfer heat from the reformate flow to a portion of a humidified air/methane mixture..." As indicated above, the '981 patent does not teach or suggest that the prior art heat exchanger 30 of Fig. 1 of the '981 patent (or the heat exchanger 50 of Figs. 2-11 of the '981 patent) transfers heat from a reformate to a water flow. On the contrary, the '981 patent indicates that water is introduced to a mixture of air and methane fuel (as shown in Fig. 1) but not that the water introduced to the fuel flow at heat exchanger 22 or humidifier 24 is for heat exchange purposes with the fuel. At best, the '981 patent discloses that tail gas heats water to form the combined fuel and water mixture in the prior art heat exchanger 22 illustrated in Fig. 1 of the '981 patent.

Further, the '981 patent does not teach or suggest a reformate cooling system having a heat exchanger including a coolant inlet, a coolant outlet, a coolant flow path to direct the portion of the process water flow from the coolant inlet to the coolant outlet, a reformate inlet, a reformate outlet, and a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path. The Examiner incorrectly asserts on page 3 of the Office action that the '981 patent discloses "the at least one heat exchanger including a coolant inlet (entrance 62), a coolant outlet (exit 64), a coolant flow path (flow path 56) to direct the portion of the humidified air/methane mixture from the coolant inlet to the coolant outlet (explicitly shown in Fig. 3), a reformate inlet (entrance 68),

a reformate outlet (exit 70), and a reformate flow path (flow path 58) to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the humidified air/methane mixture in the coolant flow path and reformate flow in the reformate flow path (explicitly shown in Fig. 2)..."

The '981 patent discloses in Fig. 3 a construction of the heat exchanger 50 having a number of passes for the humidified air/methane mixture and the reformate flow. For example, Pass 1 includes an entrance 62', an exit 64', a pass 60' of flow path 56, an entrance 68", an exit 70", and a pass 66" of flow path 58. Although pass 60' and pass 66" are parallel, the '981 patent does not teach or suggest a concurrent flow relationship between the two flow paths 56, 58. More specifically, Figs. 2 and 3 clearly show a generally opposite direction of the flow path 56 with respect to the flow path 58. With particular reference to Fig. 3, the first portion of the flow path 56 (pass 60') is in heat exchange relationship with the last portion of flow path 58 (pass 66"). Similarly, the first portion of the flow path 58 (pass 66) is in heat exchange relationship with the last portion of flow path 56 (pass 60). Therefore, the direction of flow path 56 is opposite to and not concurrent with respect to the flow path 58.

Further, the '981 patent does not teach or suggest a reformate cooling system including a heat exchanger having a sufficient effectiveness to fully vaporize the portion of a process water flow and bring reformate flow and the portion of the process water flow toward a common exit temperature under normal operating conditions for the fuel processing subsystem. The '981 patent does not teach or suggest vaporizing a water flow in a heat exchanger as a result of heat exchange relationship between a water flow path and a fuel flow path. Rather, the prior art heat exchangers 22 and 30 illustrated in Fig. 1 of the '981 patent and the heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent do not have a water flow path and a process fuel flow path such that the exit temperature of the *vaporized water* (as a result of the heat exchange of the water flow path and the fuel flow path) and the fuel have a common temperature. At best, the '981 patent discloses adding water to a fuel flow to create a *common flow path* as shown in Figs. 1 and 2 with respect to the prior art heat exchanger 22.

Further, the '981 patent does not teach or suggest a reformate cooling system including a valve connected to the coolant inlet to control the flow rate of said portion of the process water flow to the coolant inlet. On page 3 of the Office action, the Examiner asserts that the '981 patent discloses "a valve (44) connected to the coolant inlet (via line 46) to control the flow rate

of said portion of the humidified air/methane mixture to the coolant inlet...)." As indicated above, the Applicants respectfully submit that it is improper for the Examiner to interchangeably utilize the terms "process water flow" and "humidified air/methane mixture". Further, the valve 44 illustrated in Fig. 1 of the '981 patent is specifically utilized in combination with the heat exchanger 30 also illustrated in Fig. 1 of the '981 patent. As explained in more detail above, applicants respectively submit that it is improper to combine the prior art heat exchanger 30 illustrated in Fig. 1 and heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent and therefore it is not reasonable to take elements related to the heat exchanger 30 and assert that these elements can also relate to heat exchanger 50. Moreover, the stated objective of the system of Figs. 2-11 is "to eliminate the need for an active control scheme, such as the control system 38 [of the prior art system shown in Fig. 1 of the '981 patent]" and by extension to remove the associated valve. Column 6, lines 29-30. In addition, the valve 44 shown in the system of Fig. 1 of the '981 patent does not support or affect a *process water flow* of the heat exchanger 30, and the heat exchanger 30 illustrated in Fig. 1 of the '981 patent includes opposite flow paths for the same *fuel flow*.

Further, the '981 patent does not teach or suggest a reformate cooling system including a controller connected to a temperature sensor and responsive thereto to selectively control the portion of the process water flow via a valve to regulate the common exit temperature to a desired temperature range. On pages 3 and 4 of the Office action, the Examiner asserts that the '981 patent discloses "a temperature sensor (40) positioned to measure an outlet temperature of the reformate (col. 2 lines 19-20); a controller (PID controller 42) connected to the temperature sensor and responsive thereto to selectively control a portion of the humidified air/methane mixture via the valve 44 to regulate the common exit temperature to a desired temperature rage (col. 2 lines 18-29)..." As indicated above, Applicants respectfully submit that it is improper for the Examiner to interchangeably utilize the terms "process water flow" and "humidified air/methane mixture". Further, the PID controller 42 connected to the temperature sensor 40 and valve 44 disclosed in the '981 patent are specifically utilized in combination with the prior art heat exchanger 30 illustrated in Fig. 1. However, the heat exchanger 30 illustrated in Fig. 1 of the '981 patent does not include the limitations of the heat exchanger as specified in the claimed subject matter. Accordingly, the Examiner improperly suggests that the heat exchanger 50 illustrated in Figs. 2-11 anticipates the claimed heat exchanges. As indicated above, neither the

heat exchanger 30 illustrated in Fig. 1 nor the heat exchanger 50 illustrated in Figs. 2-11 include all the limitations of the heat exchanger as specified in the claimed subject matter. Moreover, the controller 42 connected to the valve 44 and the temperature sensor 40 do not support or affect *a process water flow* as specified in the claimed subject matter. The heat exchanger 30 illustrated in Fig. 1 of the '981 patent includes opposite flow paths for the same *fuel flow*. Heat exchangers 22 and 30 (with the controller 42) illustrated in Fig. 1 of the '981 patent, and heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent do not have a water flow path and a fuel (or process fuel) flow path such that the exit temperature of the *vaporized water* (as a result of the heat exchange of the water flow path and the fuel flow path) and the fuel have a common temperature.

Applicants note that the Examiner incorrectly asserts that the '981 patent anticipates the heat exchangers of the claimed subject matter as either the prior art heat exchanger 30 shown in Fig. 1 or heat exchanger 50 shown in Figs. 2-11 of the '981 patent. The '981 patent discloses that the heat exchanger 50 *replaces* the heat exchanger 30, the PID controller 42, the valve 44, and the temperature sensor 40. Accordingly, the '981 patent explicitly teaches away from combining elements of the heat exchanger 30 and the heat exchanger 50.

Burch does not cure the deficiencies of the '981 patent. Particularly, Burch does not teach or suggest a reformate cooling system including, among other things, at least one heat exchanger unit to transfer heat from the reformate flow to a portion of the process water flow, the at least one heat exchanger including a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path.

At best, Burch discloses a fuel processor thermal management system including a number of heat exchangers promoting heat transfer between a water flow and a fuel flow. Two such heat exchangers (88 and 122) allegedly fully vaporize the water flow flowing therethrough. However, as indicated above, the heat exchangers disclosed by Burch do not include all the limitations of the heat exchanger as disclosed in the claimed subject matter.

In addition, the Examiner incorrectly asserts on page 5 if the Office action that "the general concept of providing the flow of both the reformate and the process water flow being in a concurrent flow relationship falls within the realm of common knowledge as obvious mechanical expedient and is illustrated by Burch et al...". Applicants respectfully submit that out of all the

heat exchangers promoting heat transfer between a fuel flow and a water or steam flow (heat exchangers 48, 54, 68, 88, 86, 100 and 122), *none indicate the fuel flow and the water or steam flow are in a concurrent flow relationship*. Only heat exchanger 24 suggests a concurrent flow of two fluids. However, heat exchanger 24 promotes heat exchange between an air flow and a steam flow. Accordingly, Burch does not teach or suggest a process water flow and a fuel flow in a concurrent flow relationship.

Moreover, Applicants respectfully submit that the combination of the teachings in the '981 patent and Burch is improper as such a combination does not have a reasonable expectation of success. Particularly, the general *counter flow* relationship between the flow paths of heat exchanger 30 or heat exchanger 50 of the '981 patent is essential to the operation of such heat exchangers. Rearranging the flow paths of heat exchanger 30 or heat exchanger 50 of the '981 patent from counter flow to concurrent flow similar to heat exchanger 24 of Burch, as suggested by the Examiner, will deviate from the intended purpose of such heat exchangers.

In summary, Applicants respectfully submit that the combination of the teachings of the '981 patent and Burch is improper as there is no reasonable expectation of success in such a combination. The '981 patent teaches away from the Examiner's proposed combination of that the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent, the heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent and the heat exchanger 24 illustrated in Fig. 1 of Burch. Moreover, even assuming *arguendo* that the prior art heat exchanger 30 and the heat exchanger 50 of the '981 patent could be modified as suggested by the Examiner, and that the modified heat exchanger 30/50 could be combined with the teachings of Burch, the proposed combination still does not teach or suggest the elements of Claim 1.

For at least these reasons, neither the '981 patent nor Burch, alone or in combination, teaches or suggests the subject matter specified by independent Claim 1. Accordingly, independent Claim 1 is allowable. Claims 2-5 depend from independent Claim 1 and are allowable for the same and other reasons.

Independent Claim 6 and dependent Claims 7-9

Claim 6 recites

A method of operating a reformate cooling system for reducing the temperature of a reformate to within a desired temperature range for use in a fuel processing subsystem, the fuel

processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem, the method comprising the steps of:

flowing a reformate through a first flow path;

flowing a portion of the process water through a second flow path with a concurrent flow relationship to the first flow path;

transferring heat from the reformate to the portion of the process water whereby the portion of the process water is fully vaporized and the reformate and the portion of the process water approach a common exit temperature; and

controlling the portion of the process water flow rate to regulate the temperature of the reformate exiting the first flow path.

As stated above, Applicants respectfully submit that it is improper to arbitrarily select features from each of the two distinct heat exchangers 30, 50 and to recombine those features to create a hypothetical prior art heat exchanger because such a combination fails to recognize the significant differences between the two different heat exchangers 30, 50 and ignores the fact that the heat exchanger 50 illustrated in Figs. 2-11 was designed to overcome problems with the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent. Moreover, as explained in greater detail above, the '981 patent teaches away from the Examiner's proposed combination. Rather than re-present the arguments set forth above with respect to this contention, for brevity's sake, Applicants refer to the discussion above for Claim 1. With respect to Claim 6, the same arguments apply to the lack of a suggestion in the '981 patent that the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent and the heat exchanger 50 illustrated in Figs. 2-11 should or could be combined and to the contention that the '981 patent actually teaches away from the combination suggested by the Examiner.

In addition, the '981 patent does not teach or suggest a fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem. The '981 patent also does not teach or suggest a method including the acts of transferring heat from the reformate to the portion of the process water whereby the portion of the process water is fully vaporized, and the reformate and the portion of the process water approach a common exit temperature. Rather, as explained above in greater detail, the Examiner incorrectly references the "humidified air/methane mixture" of the heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent and apparently considers the humidified air/methane mixture to be the same as the *water flow* of Claim 6. The '981 patent discloses a flow of water supplied to a heat exchanger 22 and alternatively to another heat exchanger 36 (Fig. 1) to generate steam that is subsequently provided to an air/methane mixture, thereby forming the "humidified air/methane

mixture." Although it is understood that the content of the humidified air/methane mixture includes a portion of water in gaseous form, the Applicants respectfully submit that it is improper to classify such mixture as a "water flow". Moreover, Applicants respectfully submit that the heat transfer and other properties of the humidified air/methane mixture of the system of Figs. 2-11 of the '981 patent differentiate the humidified air/methane mixture from a flow of water.

Further, the '981 patent does not teach or suggest a method including the act of flowing a portion of the process water through a second flow path with a *concurrent flow relationship* to the first flow path. Rather, the '981 patent discloses in Fig. 3 a construction of the heat exchanger 50 having a number of passes for the humidified air/methane mixture and the reformate flow. For example, Pass 1 includes an entrance 62', an exit 64', a pass 60' of flow path 56, an entrance 68", an exit 70", and a pass 66" of flow path 58. Although pass 60' and pass 66" are parallel, the '981 patent does not teach or suggest a concurrent flow relationship between the two flow paths 56, 58. More specifically, Figs. 2 and 3 clearly show a generally opposite direction of the flow path 56 with respect to the flow path 58. With particular reference to Fig. 3, the first portion of the flow path 56 (pass 60') is in heat exchange relationship with the last portion of flow path 58 (pass 66"). Similarly, the first portion of the flow path 58 (pass 66) is in heat exchange relationship with the last portion of flow path 56 (pass 60). Therefore, the direction of flow path 56 is generally opposite and not concurrent with respect to the flow path 58.

Further, the '981 patent does not teach or suggest a method whereby the portion of the process water is fully vaporized and the reformate and the portion of the process water approach a common exit temperature. The '981 patent does not teach or suggest vaporizing a water flow in a heat exchanger as a result of heat exchange relationship between a water flow path and a fuel flow path. Rather, the prior art exchangers 22 and 30 illustrated in Fig. 1 of the '981 patent and the heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent do not have a process water flow path and a fuel flow path such that the exit temperature of the *vaporized water* (as a result of the heat exchange of the process water flow path and the fuel flow path) and the fuel have a common temperature. At best, the '981 patent discloses adding water to a fuel flow to create a *common flow path* as shown in Figs. 1 and 2 with respect to the prior art heat exchanger 22.

Further, the '981 patent does not teach or suggest a method including the act of controlling the portion of the process water flow rate to regulate the temperature of the reformate

exiting the first flow path. As indicated above, Applicants respectfully submit that it is improper for the Examiner to interchangeably utilize the terms "process water flow" and "humidified air/methane mixture". In addition, the PID controller 42 connected to the temperature sensor 40 and valve 44 disclosed in the '981 patent are specifically utilized in combination with the prior art heat exchanger 30 illustrated in Fig. 1. However, the heat exchanger 30 illustrated in Fig. 1 of the '981 patent does not include the limitations of the heat exchanger as specified in the claimed subject matter. The Examiner improperly suggests that the heat exchanger 50 illustrated in Figs. 2-11 anticipates the claimed heat exchanger. However, as indicated above, Applicants submit that it is improper to combine the features of the prior art heat exchanger 30 and the heat exchanger 50 of the '981 patent and neither the heat exchanger 30 nor the heat exchanger 50 includes all the limitations of the heat exchanger as specified in the claimed subject matter. Further, the controller 42 connected to the valve 44 and the temperature sensor 40 do not support or affect *a process water flow* as specified in the claimed subject matter. The heat exchanger 30 illustrated in Fig. 1 of the '981 patent includes opposite flow paths for the same *fuel flow*. Heat exchangers 22 and 30 (with the controller 42) illustrated in Fig. 1 of the '981 patent, and heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent do not have a water flow path and a fuel (or process fuel) flow path such that the exit temperature of the *vaporized water* (as a result of the heat exchange between the water flow path and the fuel flow path) and the fuel have a common temperature.

Burch does not cure the deficiencies of the '981 patent. Particularly, Burch does not teach or suggest a method including the act of flowing a portion of the process water through a second flow path with a concurrent flow relationship to the first flow path. The Examiner incorrectly asserts on page 5 if the Office action that "the general concept of providing the flow of both the reformate and the process water flow being in a concurrent flow relationship falls within the realm of common knowledge as obvious mechanical expedient and is illustrated by Burch et al...". Applicants respectfully submit that out of all the heat exchangers promoting heat transfer between a fuel flow and a water or steam flow (heat exchangers 48, 54, 68, 88, 86, 100 and 122), *none indicate the fuel flow and the water or steam flow are in a concurrent flow relationship*. Only heat exchanger 24 suggests a concurrent flow of two fluids. However, heat exchanger 24 promotes heat exchange between an air flow and a steam flow. Accordingly, Burch does not teach or suggest a process water flow and a fuel flow in a concurrent flow

relationship. Moreover, Applicants respectfully submit that the combination of the teachings in the '981 patent and Burch is improper as such combination does not have a reasonable expectation of success. Particularly, the general *counter flow* relationship between the flow paths of heat exchanger 30 or heat exchanger 50 of the '981 patent is essential to the operation of such heat exchangers. Arranging the flow paths of heat exchanger 30 or heat exchanger 50 of the '981 patent from counter flow to concurrent flow similar to heat exchanger 24 of Burch, as suggested by the Examiner, will deviate from the intended purpose of such heat exchangers.

In summary, Applicants respectfully submit that the combination of the teachings of the '981 patent and Burch is improper as there is no reasonable expectation of success in such a combination. The '981 patent teaches away from the Examiner's proposed combination of that the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent and the heat exchanger 50 illustrated in Figs. 2-11. Moreover, even assuming *arguendo* that the prior art heat exchanger 30 and the heat exchanger 50 of the '981 patent could be modified as suggested by the Examiner, and that the modified heat exchanger 30/50 could be combined with the teachings of Burch, the proposed combination still does not teach or suggest the elements of Claim 6.

For at least these reasons, neither the '981 patent nor Burch, alone or in combination, teaches or suggests the subject matter specified by independent Claim 6. Accordingly, independent Claim 6 is allowable. Claims 7-9 depend from independent Claim 6 and are allowable for the same and other reasons.

Independent Claim 10 and dependent Claims 11-14

Claim 10 recites

A reformate cooling system for reducing the temperature of a reformate to within a desired temperature range for use in a fuel processing subsystem, the fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem; the reformate cooling system comprising:

at least one heat exchanger unit to transfer heat from the reformate flow to a portion of the process water flow, the at least one heat exchanger including a coolant inlet, a coolant outlet, a coolant flow path to direct the portion of the process water flow from the coolant inlet to the coolant outlet, a reformate inlet, a reformate outlet, and a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path, the heat exchanger having a sufficient effectiveness to fully vaporize the portion of the process water flow and bring the reformate flow and the portion of

the process water flow toward a common exit temperature under normal operating conditions for the fuel processing subsystem;

an active control loop to control the flow rate of the portion of the process water flow through the heat exchanger to maintain the common exit temperature within the desired temperature range.

As stated above, Applicants respectfully submit that it is improper to arbitrarily select features from each of the two distinct heat exchangers 30, 50 and to recombine those features to create a hypothetical prior art heat exchanger because such a combination fails to recognize the significant differences between the two different heat exchangers 30, 50 and ignores the fact that the heat exchanger 50 illustrated in Figs. 2-11 was designed to overcome problems with the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent. Moreover, as explained in greater detail above, the '981 patent teaches away from the Examiner's proposed combination. Rather than re-present the arguments set forth above with respect to this contention, for brevity's sake, Applicants refer to the discussion above for Claim 1. With respect to Claim 10, the same arguments apply to the lack of a suggestion in the '981 patent that the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent and the heat exchanger 50 illustrated in Figs. 2-11 should or could be combined and to the contention that the '981 patent actually teaches away from the combination suggested by the Examiner.

In addition, the '981 patent does not teach or suggest a reformate cooling system having a fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem. The '981 patent also does not teach or suggest at least one heat exchanger unit to transfer heat from the reformate flow to a portion of the process water flow. Rather, as explained above in greater detail, the Examiner incorrectly references the "humidified air/methane mixture" of the heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent and apparently considers the humidified air/methane mixture to be the same as the *water flow* of Claim 10. The '981 patent discloses a flow of water supplied to a heat exchanger 22 and alternatively to another heat exchanger 36 (Fig. 1) to generate steam that is subsequently provided to an air/methane mixture, thereby forming the "humidified air/methane mixture." Although it is understood that the content of the humidified air/methane mixture includes a portion of water in gaseous form, the Applicants respectfully submit that it is improper to classify such mixture as a "water flow". Moreover, Applicants respectfully submit that the heat

transfer and other properties of the humidified air/methane mixture of the system of Figs. 2-11 of the '981 patent differentiate the humidified air/methane mixture from a flow of water.

Further, the '981 patent does not teach or suggest a reformate cooling system having a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path. Rather, the '981 patent discloses in Fig. 3 a construction of the heat exchanger 50 having a number of passes for the humidified air/methane mixture and the reformate flow. For example, Pass 1 includes an entrance 62', an exit 64', a pass 60' of flow path 56, an entrance 68", an exit 70", and a pass 66" of flow path 58. Although pass 60' and pass 66" are parallel, the '981 patent does not teach or suggest a concurrent flow relationship between the two flow paths 56, 58. More specifically, Figs. 2 and 3 clearly show a generally opposite direction of the flow path 56 with respect to the flow path 58. With particular reference to Fig. 3, the first portion of the flow path 56 (pass 60') is in heat exchange relationship with the last portion of flow path 58 (pass 66"). Similarly, the first portion of the flow path 58 (pass 66) is in heat exchange relationship with the last portion of flow path 56 (pass 60). Therefore, the direction of flow path 56 is generally opposite and not concurrent with respect to the flow path 58.

Further, the '981 patent does not teach or suggest a reformate cooling system including a heat exchanger having a sufficient effectiveness to fully vaporize the portion of the process water flow and bring the reformate flow and the portion of the process water flow toward a common exit temperature under normal operating conditions for the fuel processing subsystem. Rather, the prior art exchangers 22 and 30 illustrated in Fig. 1 of the '981 patent and the heat exchanger 50 illustrated in Figs. 2-11 of the '981 patent do not have a water flow path and a process fuel flow path such that the exit temperature of the *vaporized water* (as a result of the heat exchange of the water flow path and the fuel flow path) and the fuel have a common temperature. At best, the '981 patent discloses adding water to a fuel flow to create a *common flow path* as shown in Figs. 1 and 2 with respect to the prior art heat exchanger 22.

Further, the '981 patent does not teach or suggest controlling the portion of the process water flow through the heat exchanger to maintain the common exit temperature within the desired temperature range. On page 3 of the Office action, the Examiner asserts that the '981 patent discloses "an active control loop (the connection of the temperature sensor 40 and valve

44 to PID controller 42) to control the flow rate of the portion of the humidified air/methane mixture through the heat exchanger to maintain the common exit temperature within the desired temperature range (col. 2 lines 18-29, where the system is capable of performing the above limitation)." As indicated above, Applicants respectfully submit that it is improper for the Examiner to interchangeably utilize the terms "process water flow" and "humidified air/methane mixture". Further, the controller 42 connected to the valve 44 and the temperature sensor 40 do not support or affect *a process water flow* as specified in the claimed subject matter. The heat exchanger 30 illustrated in Fig. 1 of the '981 patent includes opposite flow paths for the same *fuel flow*. Heat exchangers 22 and 30 (with the controller 42) illustrated in Fig. 1 of the '981 patent, and heat exchangers 50 illustrated in Figs. 2-11 of the '981 patent do not have a water flow path and a fuel (or process fuel) flow path such that the exit temperature of the *vaporized water* (as a result of the heat exchange between the water flow path and the fuel flow path) and the fuel have a common temperature.

Burch does not cure the deficiencies of the '981 patent. Particularly, Burch does not teach or suggest a reformate cooling system including a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path. The Examiner incorrectly asserts on page 5 if the Office action that "the general concept of providing the flow of both the reformate and the process water flow being in a concurrent flow relationship falls within the realm of common knowledge as obvious mechanical expedient and is illustrated by Burch et al...." Applicants respectfully submit that out of all the heat exchangers promoting heat transfer between a fuel flow and a water or steam flow (heat exchangers 48, 54, 68, 88, 86, 100 and 122), *none indicate the fuel flow and the water or steam flow are in a concurrent flow relationship*. Only heat exchanger 24 suggests a concurrent flow of two fluids. However, heat exchanger 24 promotes heat exchange between an air flow and a steam flow. Accordingly, Burch does not teach or suggest a process water flow and a fuel flow in a concurrent flow relationship. Moreover, Applicants respectfully submit that the combination of the teachings in the '981 patent and Burch is improper as such combination does not have a reasonable expectation of success. Particularly, the general *counter flow* relationship between the flow paths of heat exchanger 30 or heat exchanger 50 of the '981 patent is essential to the operation of such heat exchangers. Arranging the flow paths of heat exchanger

30 or heat exchanger 50 of the '981 patent from counter flow to concurrent flow similar to heat exchanger 24 of Burch, as suggested by the Examiner, will deviate from the intended purpose of such heat exchangers.

In summary, Applicants respectfully submit that the combination of the teachings of the '981 patent and Burch is improper as there is no reasonable expectation of success in such a combination. The '981 patent teaches away from the Examiner's proposed combination of that the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent and the heat exchanger 50 illustrated in Figs. 2-11. Moreover, even assuming *arguendo* that the prior art heat exchanger 30 and the heat exchanger 50 of the '981 patent could be modified as suggested by the Examiner, and that the modified heat exchanger 30/50 could be combined with the teachings of Burch, the proposed combination still does not teach or suggest the elements of Claim 10.

For at least these reasons, neither the '981 patent nor Burch, alone or in combination, teaches or suggests the subject matter specified by independent Claim 10. Accordingly, independent Claim 10 is allowable. Claims 11-14 depend from independent Claim 10 and are allowable for the same and other reasons.

New independent Claim 15 and dependent Claims 16-19

Claim 15 recites

A reformate cooling system for reducing the temperature of a reformate to within a desired temperature range for use in a fuel processing subsystem, the reformate cooling system comprising:

a process water flow for supplying water to a fuel flow in the fuel processing subsystem;

at least one heat exchanger unit to transfer heat from the reformate flow to a portion of the process water flow, the at least one heat exchanger including a coolant inlet, a coolant outlet, a coolant flow path to direct the portion of the process water flow from the coolant inlet to the coolant outlet, a reformate inlet, a reformate outlet, and a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path, the heat exchanger having a sufficient effectiveness to fully vaporize the portion of the process water flow and bring the reformate flow and the portion of the process water flow toward a substantially common exit temperature under normal operating conditions for the fuel processing subsystem;

an active control loop to control the flow rate of the portion of the process water flow through the at least one heat exchanger to maintain the substantially common exit temperature within the desired temperature range.

Applicants respectfully submit that newly added independent Claim 15 is substantially similar to independent Claim 10. Accordingly, Applicants refer to the discussion above for Claim 10, for brevity's sake. With respect to Claim 10, the same arguments apply to the lack of a suggestion in the '981 patent that the prior art heat exchanger 30 illustrated in Fig. 1 of the '981 patent and the heat exchanger 50 illustrated in Figs. 2-11 should or could be combined and to the contention that the '981 patent actually teaches away from the combination suggested by the Examiner. In addition, Applicants respectfully submit that the combination of the teachings in the '981 patent and Burch is improper as such combination does not have a reasonable expectation of success, and therefore such combination does not teach or suggest all the limitations of independent Claim 15.

Further, the '981 patent does not teach or suggest a reformate cooling system having a fuel processing subsystem including a process water flow for supplying water to a fuel flow in the fuel processing subsystem. The '981 patent discloses a flow of water supplied to a heat exchanger 22 and alternatively to another heat exchanger 36 (Fig. 1) to generate steam that is subsequently provided to an air/methane mixture, thereby forming the "humidified air/methane mixture." Although it is understood that the content of the humidified air/methane mixture includes a portion of water in gaseous form, the Applicants respectfully submit that it is improper to classify such mixture as a "water flow". Moreover, Applicants respectfully submit that the heat transfer and other properties of the humidified air/methane mixture of the system of Figs. 2-11 of the '981 patent differentiate the humidified air/methane mixture from a flow of water.

Burch does not cure the deficiencies of the '981 patent. Particularly, Burch does not teach or suggest a reformate cooling system including a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path. Applicants respectfully submit that the combination of the teachings in the '981 patent and Burch is improper as such combination does not have a reasonable expectation of success. Particularly, the general *counter flow* relationship between the flow paths of heat exchanger 30 or heat exchanger 50 of the '981 patent is essential to the operation of such heat exchangers. Arranging the flow paths of heat exchanger 30 or heat exchanger 50 of the '981 patent from counter flow to concurrent flow similar to heat exchanger

24 of Burch, as suggested by the Examiner, will deviate from the intended purpose of such heat exchangers.

For at least these reasons, neither the '981 patent nor Burch, alone or in combination, teaches or suggests the subject matter specified by independent Claim 15. Accordingly, independent Claim 15 is allowable. Claims 16-19 depend from independent Claim 15 and are allowable for the same and other reasons.

CONCLUSION

In view of the above remarks, Applicants respectfully request reconsideration and allowance of pending Claims 1-19.

Respectfully submitted,

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